

reading a heterogeneous program having a plurality of executable components in at least two different forms;

obtaining a binary for a component contained in the heterogeneous program;

analyzing the binary;

building an intermediate representation for the component; and

building an intermediate representation of the heterogeneous program containing the component.

### REMARKS

Claims 1-15 and 17-43 are pending in the application. Claim 15 has been amended to more clearly recite that which the Applicant believes to be the invention. No claims have been cancelled.

### Applicants' Invention

The present invention relates generally to cross module representation of a heterogeneous program. A heterogeneous program is an executable program having components in different forms. A primary motivation for the present invention is the ability to translate and transform an executable heterogeneous program into other platform(s) without resorting to the original source code from which the executable was derived. The resulting translated or transformed program, likewise, may be heterogeneous; i.e., have components in different forms.

### Cited References

As to claim rejections under 35 U.S.C. §102 and 35 U.S.C. § 103, the Office Action relies on Patent Nos. 5,966,539 and 5,539,907 by Amitabh Srivastava et al. (the '539 patent and the '907 patent, respectively). In contrast to the present invention, neither the '539 system nor the '907 system operate on a heterogeneous program. The '539 patent discloses a system for organizing procedures among a set of object modules, which are not heterogeneous. The '539 system does not translate the object modules into a heterogeneous program. Rather, the '539 system converts linked code into machine executable code compatible with a target one of a

plurality of computer system hardware architectures. (See '539, Abstract). As such, the '539 system does not solve the problems that are solved with the present invention.

The '907 patent discloses a system for monitoring computer system performance. The system includes translating a collection of object modules into a linked code module that is subsequently converted to machine executable code for one computer platform. (See '907, Summary). The system in '907 does not perform operations on a heterogeneous program as is described in the present application.

### **Rejections of claims 19-30 under 35 U.S.C. § 101**

The Examiner rejected claims 19-30 as being unpatentable under 35 U.S.C. § 101 as being directed to a data structure having nonfunctional descriptive material. The Applicant traverses these rejections.

Claim 19 recites a computer-readable medium having stored thereon an intermediate representation instruction data structure comprising an opcode field containing data representing an opcode for the intermediate representation instruction; a destination operand field containing data representing a destination operand for the opcode identified by the opcode field; a first source operand field containing data representing a first source operand for the opcode identified by the opcode field; a second source operand field containing data representing a second source operand for the opcode identified by the opcode field; a size field containing data representing a length for the instruction identified by a combination of the opcode field, the destination operand field, the first source operand field and the second source operand field; and a mode field containing data representing an addressing mode for the instruction identified by the combination.

The Examiner in the Office Action and in a telephone interview has argued that claim 19 is nonfunctional descriptive material. Specifically, the Examiner argues that claim 19 merely recites fields of data that are not functionally interrelated. Applicants respectfully disagree. As recited, claims 19-30 claim functional descriptive material embodied on a computer-readable medium and creating functional interrelationships among both the data structure elements and a computing process.

Functional descriptive material consists of data structures which impart functionality

when employed as a computer component. See MPEP 2106.IV.B.1. Nonfunctional descriptive material includes a mere arrangement of data. See *id.* When functional descriptive material is recorded on some computer-readable medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of the technology permits the function of the descriptive material to be realized. See *id.*

The data structure recited in claim 19 includes functional descriptive material. Claim 19 recites an opcode field, a destination operand field, and first and second operand fields. The opcode in the opcode field uses the operands in the operand fields when the instruction is executed. The opcode field and operand fields are functionally interrelated and are therefore functional descriptive material. Additionally, the mode field recited in claim 19 provides an addressing mode, indicating to the computer how the instruction is to be addressed. The mode field, therefore, is functionally interrelated with the computing process. Therefore, the data structure recited in claim 19 is not "mere arrangement of data." Rather, the data structure contains functional descriptive material because it creates functional interrelationships among the data in the data structure as well as with the computing process.

Because claim 19 recites a data structure having functional descriptive material embodied on a computer-readable medium, claim 19 is believed to be statutory subject matter as defined in 35 U.S.C. § 101. Because claims 20-24 depend from claim 19 and, therefore, include all the limitations of claim 19, claims 20-24 are also believed to be statutory. Accordingly, the Applicant earnestly requests withdrawal of the rejection of claims 19-24 under 35 U.S.C. § 101.

Claim 25 recites a computer-readable medium having stored thereon a hierarchical data structure for an intermediate representation of a heterogeneous program comprising a component data structure for a component in the heterogeneous program, the component data structure comprising a procedure field containing data representing a pointer to a procedure data structure for a procedure in the component; the procedure data structure comprising a first block field containing data representing a pointer to a code block data structure for a code block in the procedure identified by the procedure field; and an instruction data structure comprising an instruction field containing data representing a pointer to an instruction data structure for an instruction in the code block identified by the first block field.

The elements of the data structure in claim 25 are functionally interrelated because the

elements may be used by a computer to manipulate portions of an intermediate representation of a heterogeneous program. The elements of the data structure recited in claim 25 are functionally interrelated to each other. For example, a first block field contains a pointer to a code block in the procedure identified by a procedure field. Therefore, claim 25 recites functional descriptive material that is embodied on a computer-readable medium.

Because claim 25 recites a data structure having functional descriptive material embodied on a computer-readable medium, claim 25 is believed to be statutory subject matter as defined in 35 U.S.C. § 101. Because claims 26-30 depend from claim 25 and, therefore, include all the limitations of claim 25, claims 26-30 are also believed to be statutory. Accordingly, the Applicant earnestly requests withdrawal of the rejection of claims 25-30 under 35 U.S.C. § 101.

**Rejections of claims 1, 2, 6-9, 11-13, 15-18, 31-35, and 39-41 under 35 U.S.C. § 102(e)**

The Examiner rejected claims 1, 2, 6-9, 11-13, 15-18, 31-35, and 39-41 under 35 U.S.C. § 102(e) based on the '539 patent. For a claim to be anticipated, every claim element must be disclosed in the cited reference. See MPEP 2131. The Applicant respectfully traverses these rejections because the '539 patent neither discloses nor suggests all the claim elements of any of the claims 1, 2, 6-9, 11-13, 15-18, 31-35, and 39-41 of the present application.

**Rejections of claims 1, 2, 6-9, 11-13, and 41**

Claim 1 recites a computerized method for translating and transforming a heterogeneous program including, in part, obtaining a binary for a component in the heterogeneous program. Claim 41 recites iterating an intermediate representation of a heterogeneous program through a computerized system to create a plurality of new version of the heterogeneous program. As discussed in the specification, a heterogeneous program consists of components in different forms. (See Application, p. 2, lines 6-7). Exemplary forms of components in a heterogeneous program are Intel x86 binary, Intel IA-64, Visual Basic byte codes, Java class files, or Virtual Machine binaries.

The cited reference '539 neither teaches nor suggests obtaining a binary of a component in a heterogeneous program. The '539 patent does not recite iterating an intermediate representation of a heterogeneous program. Indeed, the '539 patent does not mention a heterogeneous program

at all. Therefore, the '539 patent does not disclose obtaining a binary of a component in a heterogeneous program or iterating an intermediate representation of a heterogeneous program.

Furthermore, there is no motivation in the '539 patent for transformation of heterogeneous programs. In fact, the '529 patent teaches away from transformation of a heterogeneous program. The '539 patent discloses a system that converts linked code into machine executable code compatible with a target one of a plurality of computer system hardware architectures. (See '539, Abstract). As described in the '539 patent, the linked code 52 is created from a collection of object modules 40 and optional library modules 49. (See '539, Col. 4, lines 41-44). Therefore, the optimizer 50 of the '539 patent operates on all the object modules 40 to create one executable code 60' for a particular platform (i.e., not heterogeneous). (See '539, Col. 4, lines 41-44, Col. 5, lines 20-21). Therefore, the '539 patent fails to teach or suggest all of the claim elements of claims 1 and 41.

For at least these reasons, claims 1 and 41 are believed to be allowable over the art of reference. Because claims 2, 6-9, and 11-13 depend from claim 1 and, therefore, include all the limitations of claim 1, claims 2, 6-9, and 11-13 are also believed to be allowable over the art of reference. Accordingly, the Applicant earnestly requests withdrawal of the rejection of claims 1, 2, 6-9, 11-13, and 41 under 35 U.S.C. § 102(e).

### **Rejections of claims 15-18**

As amended, claim 15 recites a computer-readable medium having computer-executable instructions to cause a computer to perform a reader method including, in part, reading in a heterogeneous program having executable components for different architectures and obtaining a binary for a component contained in the heterogeneous program. As amended, claim 15 is believed to be allowable over the art of reference because the cited art fails to teach or suggest reading in a heterogeneous program or obtaining an intermediate representation of the heterogeneous program. Because claims 17-18 depend from claim 15 and, therefore, include all the limitations of claim 15, claims 17-18 are also believed to be allowable over the art of reference. Accordingly, the Applicant earnestly requests withdrawal of the rejection of claims 15, 17, and 18 under 35 U.S.C. § 102(e).

### **Rejections of claims 31-35 and 39-40**

Claims 31 and 35 are believed to be allowable over the art of reference for at least the same reasons given for claim 1. Because claims 32-34 depend from claim 31 and, therefore, include all the limitations of claim 31, claims 32-34 are also believed to be allowable over the art of reference. Because claims 39-40 depend from claim 35 and, therefore, include all the limitations of claim 35, claims 39-40 are also believed to be allowable over the art of reference. Accordingly, the Applicant earnestly requests withdrawal of the rejection of claims 31-35 and 39-40 under 35 U.S.C. § 102(e).

### **Rejections of claims 3-5, 10, 14, 36-38, 42, 43 under 35 U.S.C. § 103(a)**

The Examiner rejected claims 3-5, 10, 14, 36-38, 42, and 43 under 35 U.S.C. § 103(a) as being obvious in light of the '539 patent. In order for claims to be obvious in light of a reference, there must be some suggestion or motivation to modify the reference, there must be a reasonable expectation of success, and the prior art reference must teach or suggest all the claim limitations. (See MPEP § 2143). Applicants respectfully traverse the Examiner's obviousness rejections.

Claims 3-5, 10, and 14 depend from claim 1 and, therefore, include all the limitations of claim 35. As discussed herein with respect to claim 1, the art of record neither teaches nor suggests all of the limitations in claim 1. Therefore, the art of record neither teaches nor suggests all the claim limitations of claims 3-5, 10, and 14. As such, the Applicants believe claims 3-5, 10, and 14 are allowable over the art of record. Allowance of claims 3-5, 10, and 14 is earnestly requested.

Claims 36-38 depend from claim 35 and, therefore, include all the limitations of claim 35. As discussed herein with respect to claim 35, the art of record neither teaches nor suggests all of the limitations in claim 35. Therefore, the art of record neither teaches nor suggests all the claim limitations of claims 36-38. As such, the Applicant believes claims 36-38 are allowable over the art of record. Allowance of claims 36-38 is earnestly requested.

Claims 42-43 depend from claim 41 and, therefore, include all the limitations of claim 41. As discussed herein with respect to claim 41, the art of record neither teaches nor suggests all of the limitations in claim 41. Therefore, the art of record neither teaches nor suggests all the claim

limitations of claims 42-43. As such, the Applicant believes claims 42-43 are allowable over the art of record. Allowance of claims 42-43 is earnestly requested.


### **Conclusion**

This amendment is believed to be responsive to all points raised in the Office Action. Claims 1-15 and 17-43 remain pending in the application and are believed to clearly be allowable over the art of record. Accordingly, prompt allowance and passage of the application to issue are earnestly solicited. A separate markup with the claim amendments shown by bracketing and underlining is enclosed with this amendment in accordance with 37 C.F.R. 1.121. Should the Examiner have any remaining questions or concerns, he is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

Dated: December 16, 2002



  
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09/343,805

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Chaiken et al.	Examiner:	Steelman, Mary J.
Serial No.:	09/343,805	Group Art Unit:	2122
Filed:	June 30, 1999	Docket No.:	124240.1 M&G60001.57US01
Title:	TRANSLATION AND TRANSFORMATION OF HETEROGENEOUS PROGRAMS		

AMENDMENTS -- MARKUP

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Claims

15. (Amended Herein) A computer-readable medium having computer-executable instructions to cause a computer to perform a reader method comprising:

reading a heterogeneous program having a plurality of executable components in at least two different forms;

obtaining a binary for a component contained in [a] the heterogeneous program;

analyzing the binary;

building an intermediate representation for the component; and

building an intermediate representation of the heterogeneous program containing the component.